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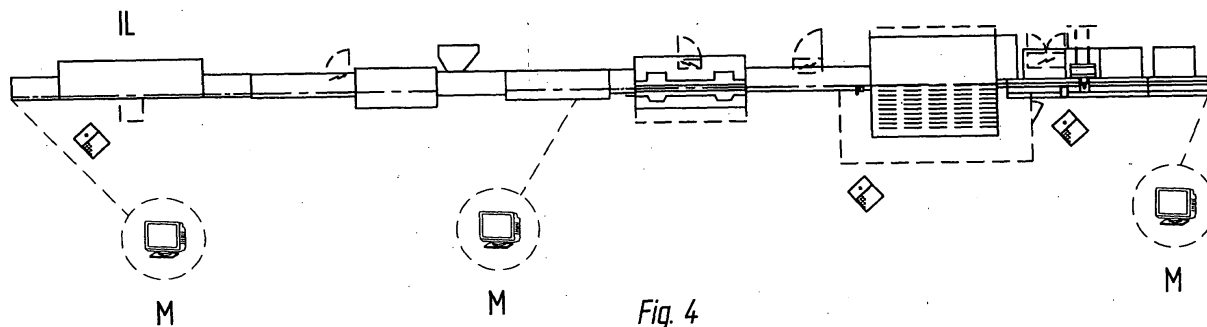
(54) **Aided managerial procedure for insulating glass production**

(57) SUMMARY

This claim concerns an aided managerial procedure especially for the production of insulating glass (panels) that coordinates many work stations, called stations, and includes, for example only and without limiting the types and number of stations: one or more machines for cutting panes of glass, whether monolithic, laminated or armoured glass; one machine to form the spacer frame

from a straight bar and obtain - by bending and/or calendering - a closed frame; a machine to fill the hollow part of the frame with hygroscopic material; a machine to apply the sealant to the sides of the spacer frame; a line (washing, assembly, sealing and so on) for the production of insulating glass.

One essential feature of the system is the special way (explained in detail in the description) to assist the operators who load and unload the machines.



## Description

### SUMMARY

**[0001]** This claim concerns an aided managerial procedure especially for the production of insulating glass (panels) that coordinates many work stations, called stations, and includes, for example only and without limiting the types and number of stations: one or more machines for cutting panes of glass, whether monolithic, laminated or armoured glass; one machine to form the spacer frame from a straight bar and obtain - by bending and/or calendaring - a closed frame; a machine to fill the hollow part of the frame with hygroscopic material; a machine to apply the sealant to the sides of the spacer frame; a line (washing, assembly, sealing and so on) for the production of insulating glass.

**[0002]** One essential feature of the system is the special way (explained in detail in the description) to assist the operators who load and unload the machines.

### DESCRIPTION

#### STATE OF THE ART AND RELATED PROBLEMS

**[0003]** Currently, one knows of: machines or plants for cutting glass, whether monolithic, laminated or armoured glass, that divide the glass sheet available on the market (usually with size 6000 mm x 3210 mm or similar or submultiples) into the final sizes; the automatic machine to produce the spacer frame by bending and/or calendaring; the automatic or semi-automatic machine to fill the hollow part of the frame with hygroscopic material; the automatic or semi-automatic machine to apply the sealant to the sides of the spacer frame; the line for the production of insulating glass (also called "multiple glazing") including one or more of the following machines (for those that are missing manual operation may be applied): edge finisher and remover to process the edges (and nearby areas) of the panel, washing machine for washing, coupling/pressing machine to couple and press two or more panes separated by one or more spacer frames (the spacer frames coming from the three previous machines), machine for gas filling, automatic sealer. The sequence of loading, unloading and moving the raw materials and the semi-finished products from one machine to the other (or from one station to another) is governed both by the common sense of the operators and by management programs that assist the operators in the work stations mainly by supplying them with print-outs or, in the cutting lines, with an unfriendly monitor displaying only the division of the "origin" sheet of glass into the "destination" sections.

**[0004]** In order to better understand the global production cycle and the importance of a coordinated management, we sum up here some of the concepts that concern both the final product, that is, the "multiple glazing" and the semi-finished products, such as the "panes"

and the "spacer frames".

**[0005]** We remark that the work flows and methods should aim at the final "multiple glazing" product and take into account that the customers (producers and/or installers of doors and windows) may order "multiple glazing" panes of different sizes and types since they are designed for different final users (that is, to be installed in houses, apartments, skyscrapers, and therefore with different types and sizes that have little in common except for being made of "panes", "spacer frames" and sealants).

**[0006]** The "multiple glazing" is made of two or more "panes" (that is, sheets of glass), each pair separated by one or more hollow "spacer frame" with micro-holes on the internal side; the spacer frames being filled with hygroscopic material and the chambers created by the panes and the frames being filled with air or gas or gas mixtures that confer the "multiple glazing" particular properties, e.g. heat insulating and/or sound insulating. The panes and frames are joined by two sealing operations, the first sealing makes the unit gas-tight (and is also useful for the production of the multiple glazing), the second operation binds the components and makes the assembly mechanically strong.

**[0007]** The "panes" used to produce the "multiple glazing" may be of different types according to the final use; for instance the external pane may be normal or reflecting (to reduce heat in summer) or laminated/armoured (to protect against trespassing/vandalism) or laminated/tempered (for safety reasons) or combined (for instance reflecting, and stratified to obtain a combination of features), the internal pane may be normal or low-emissivity (to reduce the dispersion of heat in winter) or stratified/tempered (for safety reasons) or combined (for instance low-emissivity and laminated to obtain a combination of features).

**[0008]** The "spacer frames" are made of hollow profiles that may be produced with different materials, thickness (corresponding to the distance between the panes), finishes and colours.

**[0009]** Such configuration differences (of the "panes" and "spacer frames") combine with different dimensions (standardized only in some countries but free in most) and with shapes (mostly rectangular, but also triangular, trapezoidal and even curved) and result in countless different finished products, only a small quantity, or even only a single item, to be produced of each. Moreover: each producer of "multiple glazing", since it supplies many customers, organizes the jobs according to the lists of requirements of each customer, but it also groups and mixes the jobs in order to use the raw materials in the best way, mainly the sheets of glass (large panes, usually sized 6000 mm x 3210 mm, and of different types), the "spacer frames" (according to the materials, sizes, finishes and colours) and the sealants (usually polysulphide, polyurethane, silicone, hot melt, some two-components, other single-components, some available both as single and as two-components). A series

of more lists (or bill of materials or data base), each from a customer, are joined in one or more union lists, in which the codes of the single customers are mixed in such a way as to best exploit the sizes of raw materials, in order to reduce waste and both the machines and the manpower use. This process is carried out by means of management and optimization programs, for instance, for cutting glass. At the end of the process, the shipment units of the finished products must be reconstructed according to the destination, that is, the customer. In all these stages, the operators are currently inadequately assisted, since they only receive printouts that list the "multiple glazing" for each customer and the components of the multiple glazing by uniform types, to deal with both as raw materials and as processing. The developments in electronic data processing make it possible to produce countless printouts, with different sorting criteria, and the operators are consequently swamped with an abnormal quantity of information. This invention intends to reduce the flow of information burdening the operators by communicating only the essential information in a synopsis and intelligent way.

**[0010]** A production line for "multiple glazing" (mainly rectangular, but also of other shapes) requires many cascading processes, and productivity and service to the customer may be improved if such processes, loading, unloading and moving of raw materials are rationalized, managed and assisted.

**[0011]** The processes for the production of the "multiple glazing", each of them requiring a special machine, to be arranged in series or in parallel with other complementary ones, are, as a non-limiting example, the following ones:

*CUTTING* of the source panes to divide into the sizes required for the "multiple glazing"; this is carried out by machines external to the "multiple glazing" production line;

*FINISHING OF THE EDGES* of the panes to eliminate defects that could give rise to cracks and to reduce the sharpness of the edges that could cause cuts while handling the panes.

*REMOVAL* of the coating from the most external part of the surfaces of the panes in order to enable the sealants to adhere and ensure their durability;

*WASHING* of each pane, alternating internal pane/external pane (as defined in Figure 1).

*QUALITY CONTROL* either electronic and automatic or visual and semi-automatic;

*APPLICATION OF THE SPACER FRAME*: the frame, through the processes of FORMING, FILLING and SPREADING of the first adhesive sealant for tightness (operations carried out in machines that do not belong to the "multiple glazing" production line) is then applied - in almost all plants - manually to one of the "multiple glazing" panes in a special station of the "multiple glazing" production line;

*COUPLING AND PRESSING* of the panes and

spacer frames;

*FILLING WITH GAS* the created chamber(s);

*APPLICATION OF SEPARATORS* (packaging items);

*SECOND SEALING*;

*PREPARATION OF THE CARRIAGE* for the customer;

**[0012]** The processes mentioned above may be carried out by each machine automatically or semi-automatically, or (at least in some cases, such as the application of the spacer frame, of the separators and the preparation of the carriage) by the same operator.

**[0013]** The search for prior art registered or disclosed for the management of such processes, or similar ones, has found only the following invention.

Patent EP 0 252 066, German priority 1707 dated 23.06.1986, applicant Lisec Peter. This invention concerns only the identification of the components of the insulating glass insofar as the same are marked - for instance - with bar codes, and each machine is equipped with a reader and the production is therefore managed, as well the production parameters of the machines are set according to the features (sizes, shapes, etc.) of the components being processed.

**[0014]** The search for further prior art, in a very crowded technical sector, from the viewpoint of industrial property rights, such as that of the machines and lines for the production of multiple glazing, has not found anything similar to this invention, even in the countless fairs held all over the world, where promptly one can find on display the new ideas and the relevant machines.

**[0015]** The same applies to the technical magazines.

**[0016]** The main problems in the art prior to the invention described above are the following ones:

# the identification code must be applied manually, because an automatic device would be too complex, to the components of the multiple glazing

# in case of human error in the application of the label with the identification code, the machine would adopt wrong processing parameters and, in addition to the failure of the process, the machine may be damaged or the personnel may be injured, because the movements of the machine's actuators and of the material being processed would not be combined but would interfere dangerously.

# The production flow is too inflexible, because it is based on the requirement of codification of the components.

# Qualified operators are needed even for simple operations such as loading and unloading the semi-finished products.

**[0017]** The main purpose of the object of this patent application is to solve the technical problems mentioned above and eliminate the drawbacks of the prior art men-

tioned above by means of an assisted coordination system for the production of "multiple glazing", that is, a system based mainly on a software program that assists the operators in loading and unloading the machines with raw materials or semi-finished products.

#### DESCRIPTION OF THE INVENTION

**[0018]** To better understand the principles underlying the object of this invention, we have already described above the types of material being processed ("multiple glazing") and of its components ("sheets of glass" and "spacer frames") and an overview of the sequence of operations required for the production.

**[0019]** We now describe how, in the aided managerial procedure object of this application, the operators are assisted in loading, unloading and moving the components of multiple glazing through the several work stations, said stations including, as a non-binding and non-limiting example concerning the number and types of stations: lines for cutting "panes of glass"; one machine to produce the spacer frame from a straight bar and obtain, by bending and/or calendaring, a closed frame; one machine to fill the hollow part of the frame with hygroscopic material; one machine to apply the sealant to the sides of the spacer frame and finally a line for the production of "multiple glazing" which itself is composed of several machines.

**[0020]** The essential feature of the aided managerial procedure is to use in each position where there is an operator, or at least in the most important positions, a monitor, or an equivalent device, that displays a 3D synopsis and dynamic view of the components while they are picked up from the other components of the same level during the feeding of a station or while they are accumulated with other components of the same level during the unloading of a station. The operator is assisted because the component being processed is highlighted, in relation to the other components of the same level, by means of a different colour, by blinking, or by an arrow, etc. Moreover, the logic of progression of the components to be handled is always governed by the need of arranging the finished products in accordance with the progression required by the priorities of delivery of the finished product.

#### WAYS FOR THE REALIZATION OF THE INVENTION

**[0021]** To better describe a realization of the invention, that includes all the equivalent realizations, we comment a set of figures in the following text (FIGURES 2, 3, 4) that concern an essential arrangement, which does not exclude alternative configurations based on the same principle, and explain briefly, in the same order as the component of the figures, the stages of the production cycles as they are coordinated and assisted by the software program(s) of this invention.

**[0022]** FIGURE 1, which concerns the "multiple glaz-

ing" product already described, displays the problems of differentiating the products to be laid on the carriages that come from the production grouped by types but assigned to different customers, each of them requiring a mix of types and dimensions. This figures displays the edge of the "double glazing" in a non-limiting example of combinations: 1A normal, 1B triple glazing, 1C stepped panes, 1D laminated external pane and low-emissivity internal pane, 1E tempered reflecting external pane and low-emissivity stratified internal pane. The two types of sealant used are also shown: in black, the butyl sealant for tightness (first sealing), in dotted lines, the sealant (polysulphide or polyurethane or silicone) required to achieve mechanical strength (second sealing). The external/internal position is marked visually by the icons of the sun (external side) and of a heater (internal side).

**[0023]** FIGURES 2, 3, 4 show a possible version of the machines coordinated for the production of the insulating glass starting from the raw materials which are the "panes" to be cut, the "spacer frames", the sealants, up to the finished product, which is packed on the carriages or stands that will be subsequently, and almost in real time, shipped to the customer. They are indicated by pairs of capital letters, respectively in FIGURE 2: [VC] the vertical cutting table; [HC] the horizontal cutting table; in FIGURE 3: [PB] the automatic profile bender; [DF], the desiccant filler; [MB] the manual butyliser; [AB] the automatic butyliser; in FIGURE 4: [IL] the insulating glass line, the line for the production of insulating glass composed of the sections for edge finishing, washing, assembly, pressing, filling with gas, and sealing. The monitor symbol and the letter [M] mark the positions where a monitor assists the view of the operator with a "3D, synopsis and dynamic", by blinking or in some other way highlighting the item to be picked up from the set of items or the position in the subsequent stage that the processed item is to be inserted.

**[0024]** The subsequent FIGURES 5, 6, 7 (shaded, not due to a mistake made by the draftsman, but, as they concern the software part of the invention) better displays the interface with the operator.

**[0025]** FIGURE 5 displays the operating logic of the software part of the invention, as far as cutting of the "pane" is concerned, that is: in the first part, one can see a part of the storage of the glass panes ("origin"), for instance, a type of panes, where the well-known waste reduction program cuts them into the "destination" sizes; in the second part, one can see the operation of the software part of this invention that reorders the "origin" panes and, if this is not enough, re-runs the waste reduction programs, to organize the subsequent processes according to the priorities of delivery of the several types of multiple glazing to the final customers.

**[0026]** FIGURE 6 shows, for the part concerning cutting of the panes, the messages that the software part, which is an essential component of this invention, sends to the operator to assist him in handling each semi-fin-

ished product that comes out of the cutting table(s) and moving it to the correct carriage, and -within the carriage- to the correct position, so that in the subsequent processing station (in this case the washing machine of the insulating glass line) is fed with semi-finished products in the correct sequence according to the priorities of delivery of the several types of multiple glazing to the final customers.

**[0027]** FIGURE 7 shows, for the part concerning the production of the "spacer frame", the messages that the software part, which is an essential component of this invention, sends to the operator to assist him in destining each semi-finished product that comes out of each machine that takes part in the production of the frame to the correct carriage so that in the subsequent processing station (in this case the coupling machine of the insulating glass line) is fed with semi-finished products in the correct sequence according to the priorities of delivery of the several types of multiple glazing to the final customers.

**[0028]** FIGURE 8 shows, for the part concerning the insulating glass line, the messages that the software part, which is an essential component of this invention, sends to the operators, at the feeding of the washing machine and at the delivery of the sealer respectively, to assist them in handling the semi-finished products ("panes") and the finished product ("multiple glazing") according to the priorities of delivery of the several types of multiple glazing or in such a way as to optimize these priorities.

**[0029]** This invention may be realized in many variations (as compared to what can be seen in the drawings), all falling within the scope of the invention: which is, assisting the operator with a visual representation of the components to be fed and delivered in each stage of production, such variations may concern the methods of representation (orthogonal projections, 3D views, axonometric projections, perspective views, etc. the colours, the highlighting method), the positions of the monitors (external to the machine or on the machine itself, etc.), the quantity of monitors (as a function of the combinations of machines that carry out the process and of the extent of details to be supplied).

## Claims

1. Procedure for the production of insulating glass, whose main components are the glass panes, the spacer frame and the sealants; composed of the main stages of cutting of the panes, production of the spacer frames, extrusion of the sealants and assembly of the components **characterized by** the fact that the operator is assisted by overview devices [M] in the operations of picking up the components from the machines, inserting the components into the machines and moving the components between the machines.

2. Procedure for the production of insulating glass as per claim 1 **characterized by** the fact that the overview devices [M] are monitors [M] that display the images of the components in each stage of picking up from each machine, insertion into each machine and moving between machines.
3. Procedure for the production of insulating glass as per claim 1 **characterized by** the fact that the overview devices [M] are governed by a software program that optimizes, also in several runs, and scans the preparation of semi-finished products to prioritize the composition the carriages containing the finished products according to the combination of the same finished products and the priorities of delivery to the customers.
4. Procedure as per claim 1 **characterized by** the fact that it concerns only a part of the cycle for the production of insulating glass.
5. Procedure as per claim 4 **characterized by** the fact that it concerns processing cycles for panes other than those for the production of insulating glass.
6. Procedure as per one or more of the previous claims **characterized by** the fact that in the synopsis display of the monitor [M] are shown both the set of components and the component involved in the operation.
7. Procedure as per claim 6 **characterized by** the fact that in the synopsis display of the monitor [M] the component involved in the operation is highlighted.
8. Procedure as per one or more of the previous claims **characterized by** the fact that the software programs and the overview devices [M] interact also with machining or management processes upstream of and downstream of the insulating glass production process.
9. Procedure as per one or more of the previous claims **characterized by** what is described and illustrated in the attached drawings.

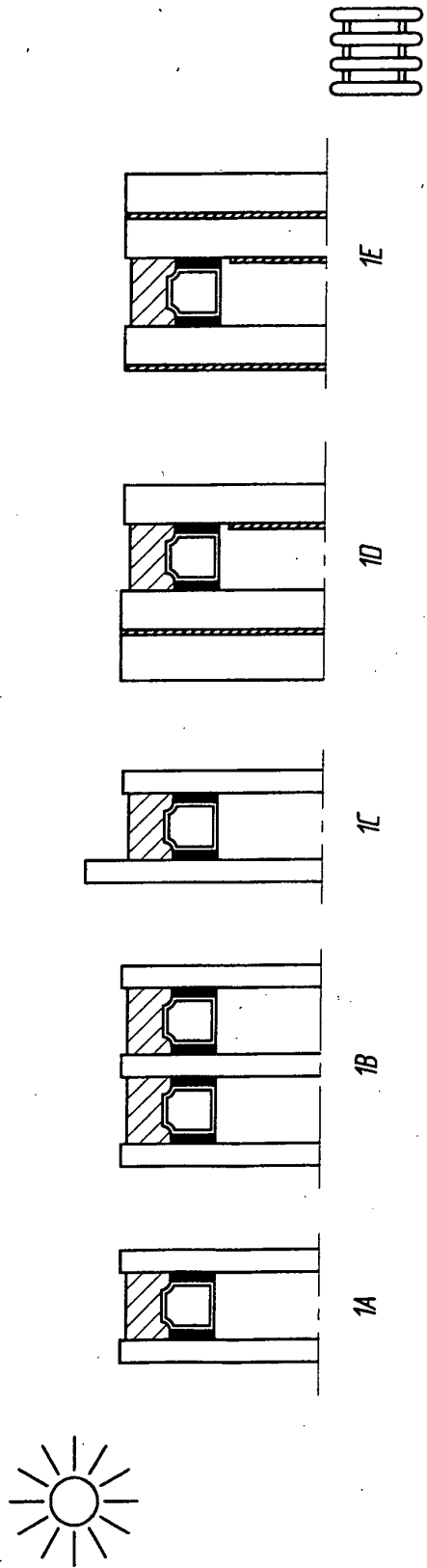


Fig. 1

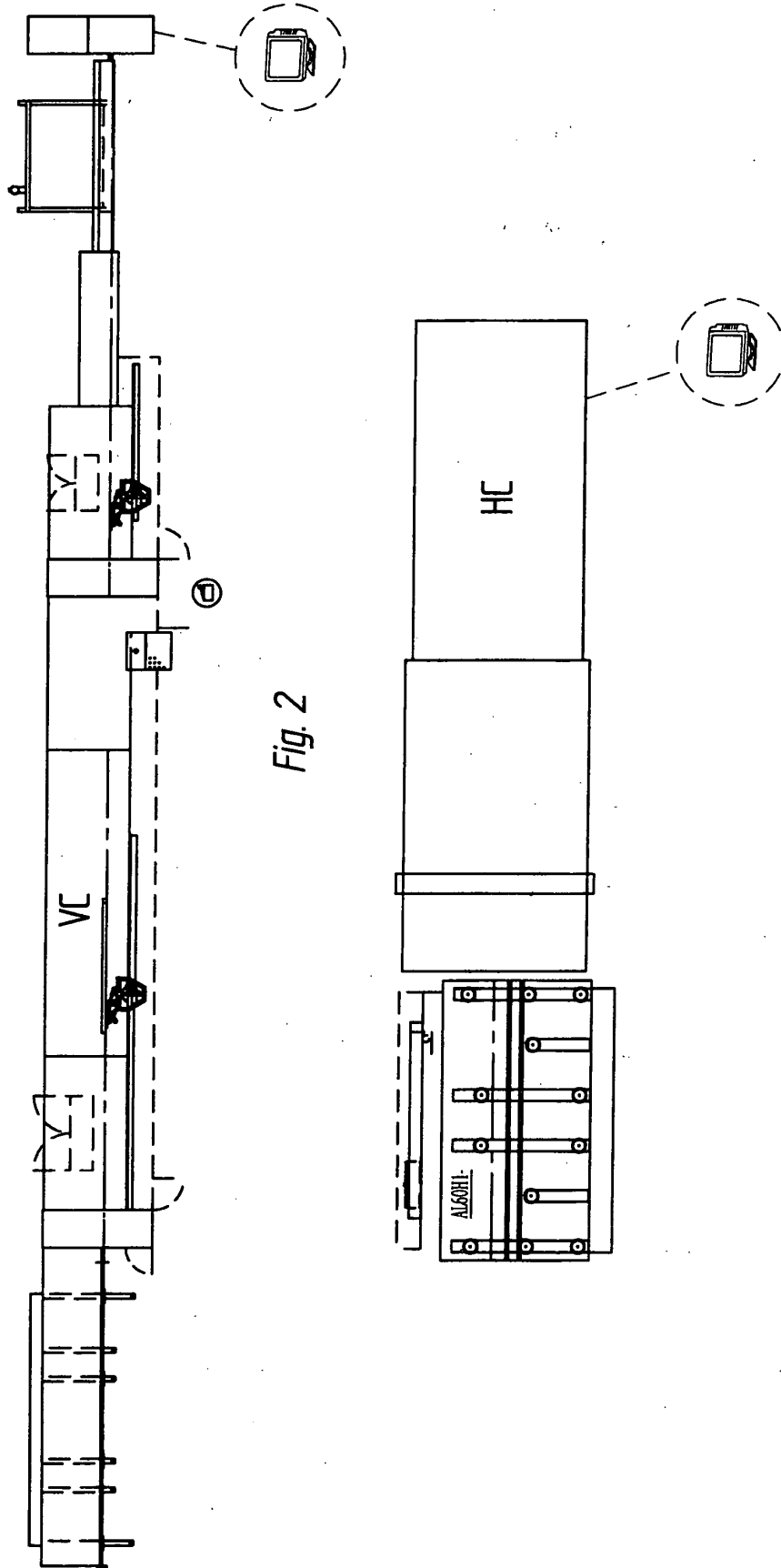


Fig. 2

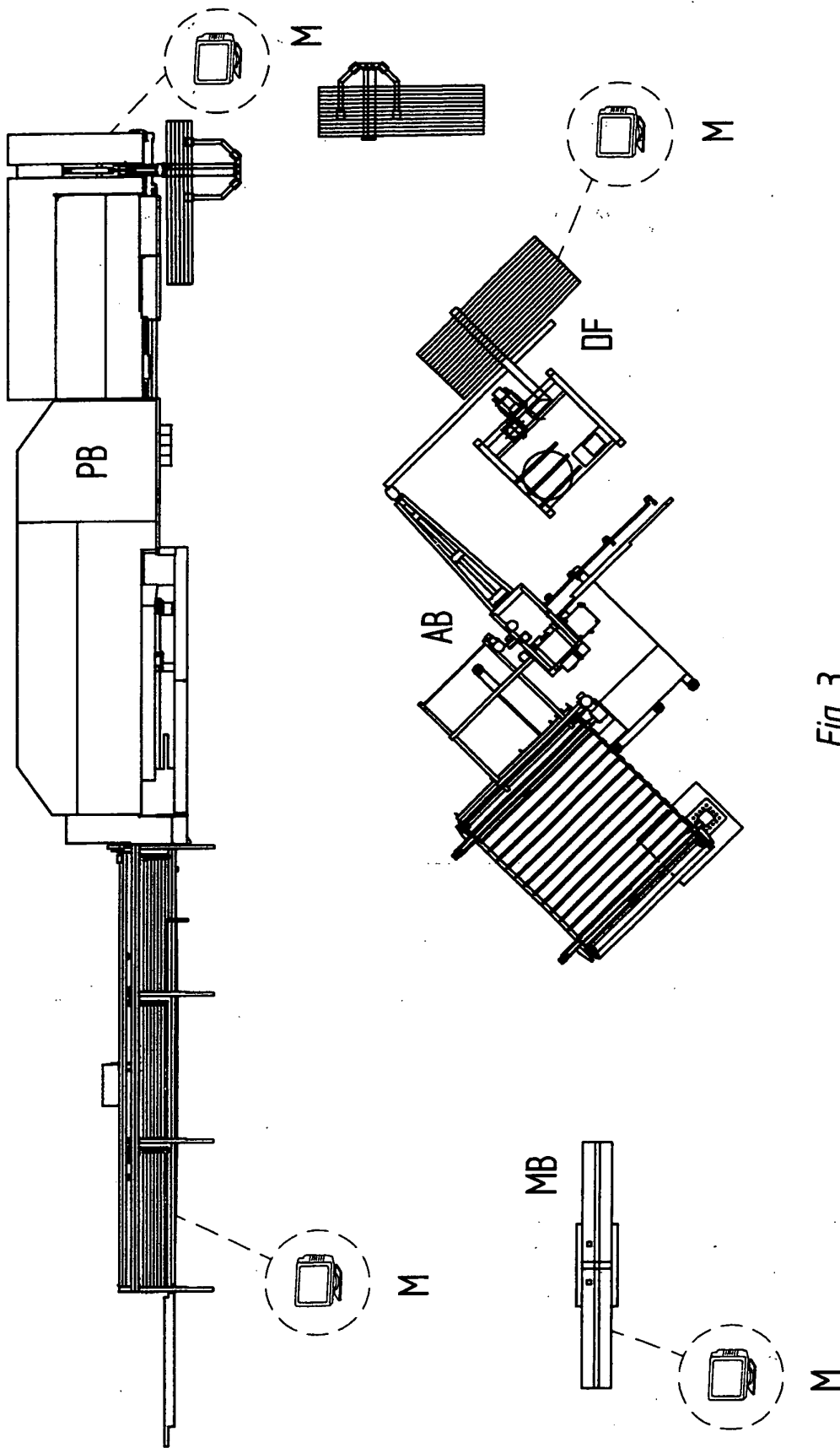


Fig. 3

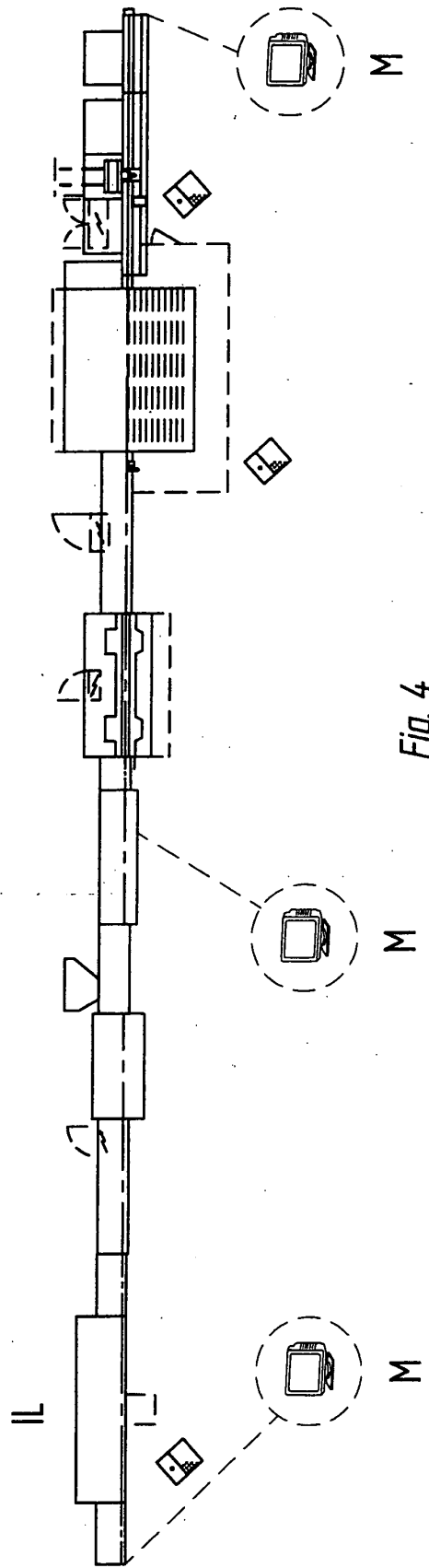
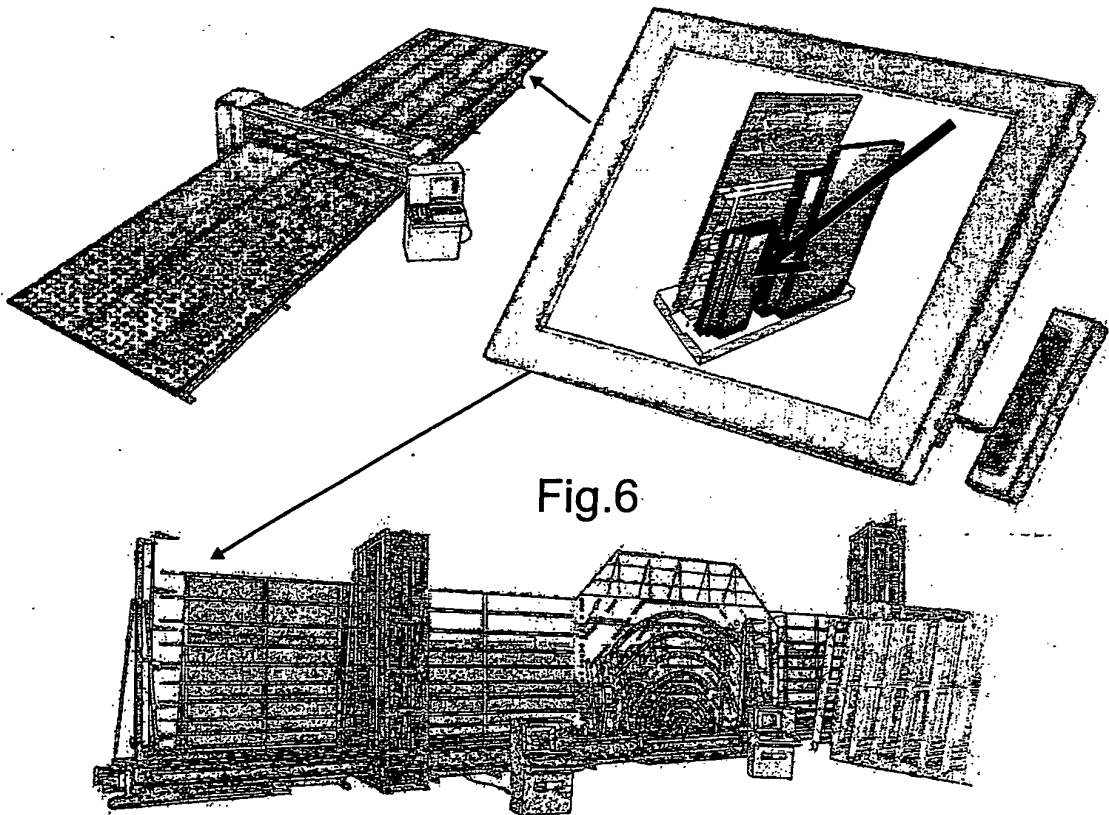
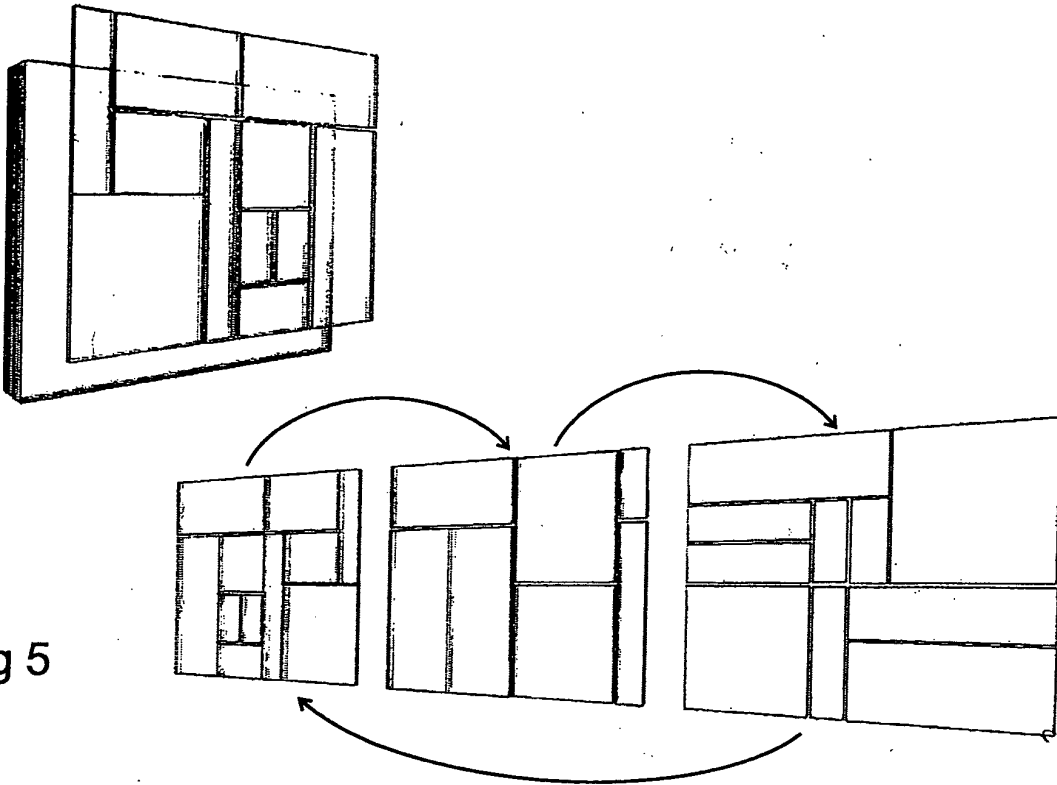


Fig. 4



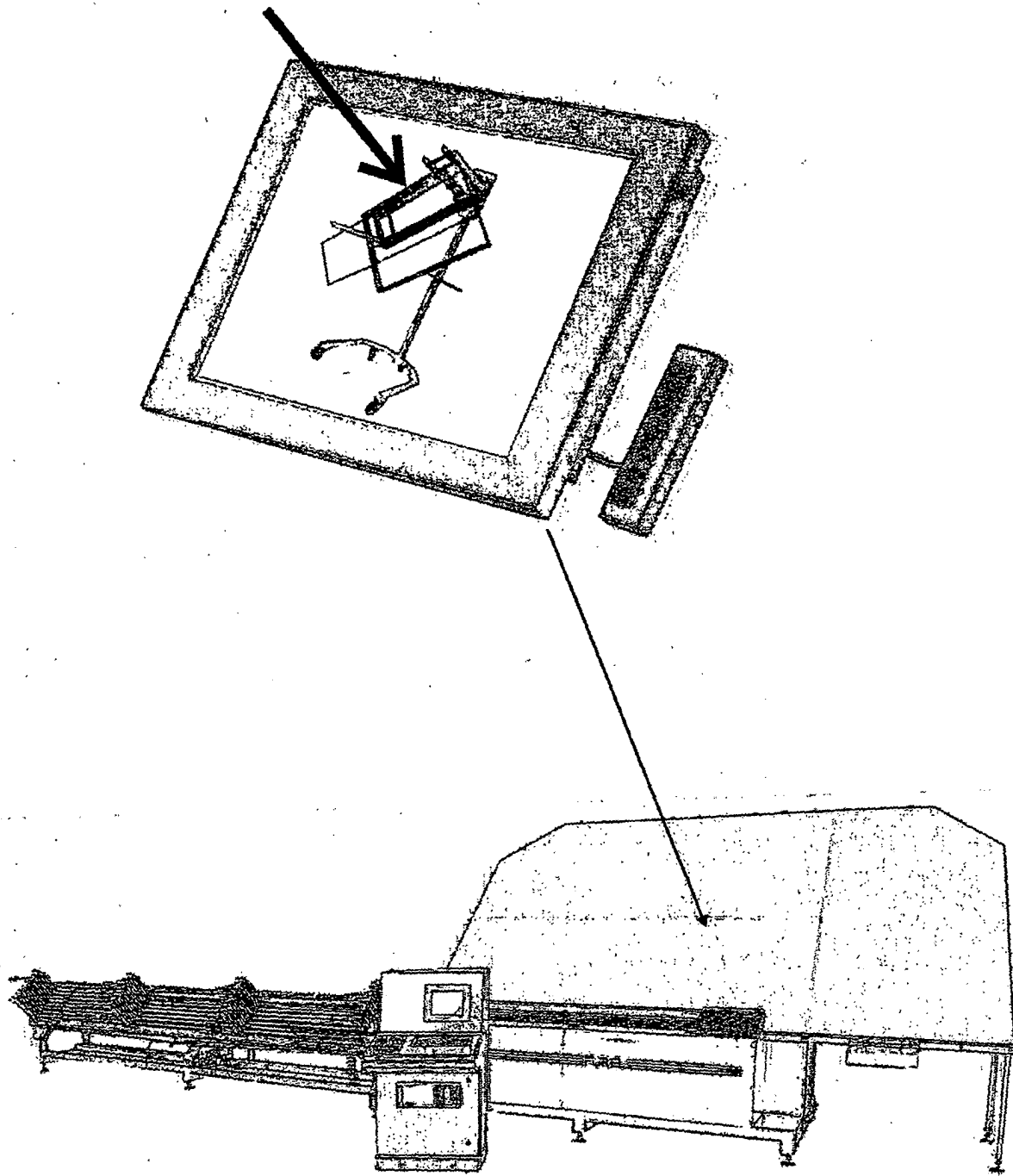


Fig.7

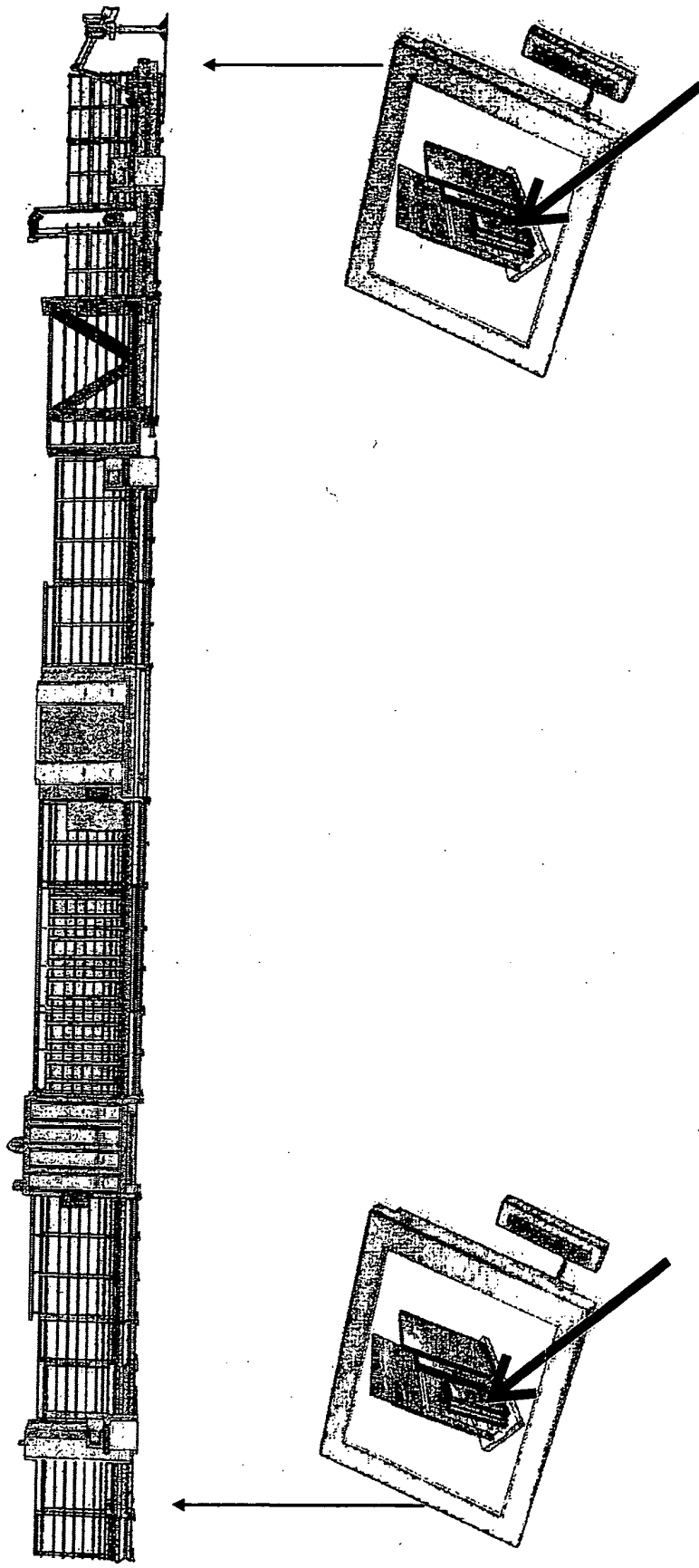


Fig.8